

Permanence of Paper for Publications and Documents in Libraries and Archives

Abstract: This standard establishes criteria for coated and uncoated paper that will last several hundred years without significant deterioration under normal use and storage conditions in libraries and archives. This standard identifies the specific properties of such paper and specifies the tests required to demonstrate these properties.

Developed by the
National Information Standards Organization

Approved October 26, 1992 by the
American National Standards Institute



Bethesda, Maryland, U.S.A.

**Published by
NISO Press
P.O. Box 1056
Bethesda, MD 20827**

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ISSN: 1041-5653
ISBN: 1-880124-00-9

Printed in the United States of America

 This paper meets the requirements of ANSI/NISO Z39.48-1992 (Permanence of Paper).

Library of Congress Cataloging-in-Publication Data

Permanence of paper for publications and documents in libraries and archives/ approved October 26 1992, by the American National Standards Institute ; developed by the National Information Standards Organization. Bethesda, Md., U.S.A.: NISO Press, c1993.

p. cm. — (National information standards series, ISSN 1041-5653)

Cover title: American national standard -- Permanence of paper for publications and documents in libraries and archives.

Rev. ed. of: American national standard for information sciences—Permanence of paper for printed library materials. c1985.

“ANSI/NISO Z39.48-1992.”

ISBN 1-880124-00-9

1. Permanent paper—Standards—United States. 2. Library materials—Standards—United States. 3. Archival materials—Standards—United States. 4. Books—Standards—United States. I. National Information Standards Organization (U.S.) II. American National Standards Institute. American national standard—Permanence of paper for printed library materials. III. Title. IV. Series.

Z701.A56 1993
025.3—dc20

93-148

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Foreword

(This foreword is not a part of the American National Standard for Permanence of Paper for Publications and Documents in Libraries and Archives, ANSI/NISO Z39.48-1992. It is included for information only.)

This standard is a revision of American National Standard for Permanence of Paper for Printed Library Materials, Z39.48-1984. It was prepared by Standards Committee II of the National Information Standards Organization. Standards Committee II was established in December 1986 to revise ANSI Z39.48-1984 to encompass coated paper. In 1988, the Committee's charge was broadened to include review and revision of the standard's specifications for uncoated paper.

The objective of this standard is to establish criteria for coated and uncoated paper that will last several hundred years, without significant deterioration, under normal use and storage conditions in libraries and archives. Actual observation and laboratory test results indicate that paper meeting the requirements described in this standard should survive for hundreds of years. Librarians, archivists, and other persons concerned with the preservation of library materials are all too familiar with the speed with which acidic paper embrittles. This embrittlement has made probable the loss of the original hard copy format of much of the published record from the 19th and 20th centuries and has necessitated huge expenditures for copying deteriorating publications to more permanent media. By identifying the properties consistent with paper longevity, the standard seeks to encourage wider use of permanent paper so that comparable future preservation problems can be prevented.

To obtain the data needed for its work, NISO commissioned the Institute of Paper Science and Technology to conduct a series of tests of coated papers and of uncoated alkaline papers with varying lignin contents and alkaline reserves. In preparing the revision, the Standards Committee II considered the results of these tests, the results of relevant tests conducted under other auspices, and comments from paper makers, publishers, printers, and the preservation community. The current standard represents a reasonable interpretation of currently available information on the permanence of paper, but there are a number of unresolved questions that require further investigation. There is evidence that some papers that do not meet all of the standard's criteria, e.g., some alkaline papers with higher than 1% lignin levels, can exhibit excellent retention of physical properties. Additional research is needed, however, to define more

precisely the conditions under which higher levels of lignin are compatible with paper permanence. The next revision of the standard should reflect the results of such research.

This standard includes parameters that are relevant to the permanence of paper. It is assumed that other characteristics, such as brightness, opacity, and thickness, will be specified by purchasers based on the intended use of their publications and documents. As these parameters have no apparent effect on the permanence of paper they are excluded from this standard. Tests after artificial aging are also excluded because the criteria for unaged paper specified in the standard appear to be adequate predictors of acceptable retention of properties after aging. The standard does not dictate the use of either virgin or recycled paper pulp. As with virgin papers, some recycled papers will meet the standard's criteria and others will not.

There are a number of factors beyond the scope of this standard that affect the permanence of paper in publications and documents. These include the environmental conditions under which materials are stored, the method by which publications are bound, and the use of printing inks that do not adversely affect paper permanence.

Permanent paper should be used for all publications and documents of potentially long-lasting value. Publishers should indicate the use of permanent paper in the publications themselves and in advertising, packaging, etc. as set forth in this standard in Section 6, "Notice of Compliance."

Suggestions for improving this standard are welcome. They should be sent to the National Information Standards Organization, 4733 Bethesda Avenue, Suite 300, Bethesda, MD 20814.

This standard was processed and approved for submission to ANSI by the National Information Standards Organization. NISO approval of this standard does not necessarily imply that all Voting Members voted for its approval. At the time it approved this standard, NISO had the following members:

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Permanence of Paper for Publications and Documents in Libraries and Archives

1. Introduction

1.1. Purpose

This standard establishes criteria for coated and uncoated paper that will last several hundred years without significant deterioration under normal use and storage conditions in libraries and archives. This standard identifies the specific properties of such paper and specifies the tests required to demonstrate these properties.

By identifying the properties consistent with paper longevity, the standard seeks to encourage wider use of permanent paper and to promote recognition of its importance to the long-term preservation of recorded knowledge. As part of this process, the standard recommends that publications printed on paper that meets these criteria be identified by a prominently displayed symbol and statement.

1.2. Scope

The standard applies to coated and uncoated paper used in the production of publications and documents acquired and retained by libraries and archives. Examples include:

- (1) Important works of fiction and nonfiction
- (2) Scholarly periodicals, monographs, and reprint editions
- (3) Collected editions
- (4) Encyclopedias, dictionaries, bibliographies, directories, indexes, abstracts, and other reference works
- (5) Government documents
- (6) Titles not appropriate for transfer to other formats
- (7) Original documents, records, and forms, including computer output and photocopy replacements
- (8) Printed musical scores
- (9) Original art and art reproductions.

2. Definitions

Alkaline reserve — A compound (e.g., calcium carbonate) in paper that neutralizes acid that might be generated from natural aging or from atmospheric pollution.

Cataloging in Publication (CIP) program — A cooperative effort between the Library of Congress and book publishers in the United States that provides prepublication cataloging information, in standard library format, for forthcoming monographic titles. The information appears on the verso of the title page.

Coated paper — Paper with a surface coating of a minimum weight which has been applied for the purpose of improving the paper's appearance and printability. Coated paper has a coating weight equal to or greater than 2.5 lbs. (3.75 g/m²) per side for papers less than 50 lbs. in total basis weight (75 g/m²) and equal to or greater than 4.0 lbs. (6 g/m²) per side for papers 50 lbs. (75 g/m²) or heavier, with at least 50% of the coating weight in pigment.

Lignin — A brown-colored organic substance which acts as an interfiber bond in woody materials.¹ Natural binding constituent of the cells of wood and plant stalks, a complex three-dimensional polymer of phenylpropane or propylbenzene structure. The chemistry of lignin is characterized by having hydroxyl or methoxyl groups attached to the benzene carbon atoms.²

Paper — A homogeneous sheet of felted cellulose fibers, bound together by interweaving and by the use of bonding agents.²

Basis weight — The mass in pounds of a ream of paper of a given sheet size and number of sheets. The basis weight of book paper is equal to the weight of 500 sheets measuring 25 inches by 38 inches. The basis weight of writing or printing paper is equal to the weight of 500 sheets measuring 17 inches by 22 inches.

Grammage — The mass per unit area expressed in grams per square meter (g/m²). (See TAPPI T410 om-88.)

1. Lavigne J.R., Patrick K.L. *Pulp & Paper Dictionary*. San Francisco: Miller Freeman Publications, Inc., 1986; 329-30.

2. Smook G.A. *Handbook of Pulp & Paper Terminology*. Vancouver: Angus Wilde Publications, 1990; 44.

Table 1 — Approximate equivalent basis weights and grammages of commonly encountered book and writing papers

Basis grammage (g/m ²)	Basis weight of book paper (lbs)	Weight of writing paper (lbs)
90	60	24
75	50	20
60	40	16
45	31	12

Figure 1 — Tear index

$$\text{tear index} = \frac{\text{tear resistance (mN)}}{\text{grammage of paper (g/m}^2\text{)}} = \frac{\text{tear resistance (g)} \times 9.81}{\text{grammage of paper (g/m}^2\text{)}}$$

Weight equivalents — Table 1 lists approximate equivalent basis weights and grammages of commonly encountered book and writing papers.

pH — The negative logarithm of the hydrogen ion concentration in an aqueous solution or the logarithm of the reciprocal of the hydrogen ion concentration, measured on a scale of 0-14. Numerically expressed, pH 7 is neutral; lower numbers are acidic, higher numbers are alkaline.

Permanence — The ability of paper to last at least several hundred years without significant deterioration under normal use and storage conditions in libraries and archives.

Tear index — An index of durability, expressed in units of mNm²/g (millinewtons meter²/gram), that is computed from a paper's tear resistance according to the formula presented in Figure 1.

Uncoated paper — Paper with no surface coating in excess of a maximum weight. Uncoated paper has surface coating of less than 2.5 lbs. (3.75 g/m²) per side for papers less than 50 lbs. in basis weight (75 g/m²) and less than 4.0 lbs. (6 g/m²) per side for papers 50 lbs. (75 g/m²) or heavier.

3. Referenced Standards

This standard is intended to be used in conjunction with the following standards. When these standards are superseded by revisions, the revisions shall apply:

ASTM D 4988-89, Standard Test Method for Determination of Calcium Carbonate Content of Paper³

TAPPI T236 cm-85, Kappa Number of Pulp⁴

TAPPI T410 om-88, Grammage of Paper and Paperboard⁴

TAPPI T414 om-88, Internal Tearing Resistance of Paper^{4,5}

TAPPI T509 om-88, Hydrogen Ion Concentration (pH) of Paper Extracts — Cold Extraction Method⁶

TAPPI T529 om-88, Surface pH Measurement of Paper⁶

4. Minimum Requirements for Uncoated Paper

Uncoated permanent paper shall meet all of the following requirements:

3. Available from ASTM, 1916 Race Street, Philadelphia, PA 19103.

4. Available from TAPPI, Technology Park/Atlanta, P.O. Box 105113, Atlanta, GA 30348-5113.

5. To assure maximum consistency of results, it is recommended that suppliers subscribe to some form of comparative test program, such as CTS-TAPPI Collaborative Reference Service, Collaborative Testing Services, Inc., 340 Herdon Parkway, P.O. Box 1049, Herndon, VA 22070.

6. Available from ASTM, 1916 Race Street, Philadelphia, PA 19103.

Table 2 — Tear resistance values for commonly encountered weights of uncoated paper

Grammage (g/m ²)	Basis weight of book paper (lbs)	Basis weight of writing paper (lbs)	Minimum average machine-direction tear resistance (g)	Minimum average machine-direction tear resistance (mN)
90	60	24	50	491
75	50	20	40	392
60	40	16	32	314
45	30	12	24	235

4.1. pH

pH in the range of 7.5 to 10.

The manufacturer's certification of the paper's pH value and of the use of an alkaline process in its manufacture may be accepted as proof that the paper meets this requirement. As confirmation, an indication of the approximate pH of the paper may be obtained by: (a) splitting the paper, using a dry delaminating method to expose an internal surface, and determining the pH of the internal paper by surface measurement in accordance with TAPPI T529 om-88 as modified⁷ or (b) applying a pH indicator (e.g., chlorophenol red as liquid or in an indicator pen) to the core surface.

Note: Extraction methods (e.g., TAPPI T509 om-88) and surface pH measurement (TAPPI T529 om-88) are appropriate for determining the pH of uncoated paper only if the paper has no surface sizing or other lightweight surface coatings. Such lightweight surface coatings may not be apparent upon visual inspection of the paper.

4.2. Tear Resistance

Minimum average machine direction tear index of 5.25 mNm²/g (see TAPPI T414 om-88).

Table 2 lists for several commonly encountered weights of paper the tear resistance values in grams and millinewtons which are equivalent to a tear index of 5.25 mNm²/g.

4.3. Alkaline Reserve

Minimum alkaline reserve equivalent to 2% calcium carbonate based on oven dry weight of the paper (see ASTM D 4988-89).

4.4. Paper Stock

The paper shall contain no more than 1% lignin by weight of the fiber content of the paper, as indicated by a Kappa number not greater than 7 (see TAPPI T236 cm-85).

Note: Testing has shown that some papers with higher lignin levels which otherwise meet the requirements of this standard can exhibit excellent retention of physical strength after accelerated aging.

5. Minimum Requirements for Coated Paper

Coated paper shall meet all of the following requirements:

5.1. pH

pH of core paper in the range of 7.0 to 10.0, exclusive of the coating. A neutral pH (7.0) is acceptable for the core of a coated paper if the paper as a whole, including the coating, meets the minimum alkaline reserve requirements. (See Section 5.3.)

The manufacturer's certification of the core paper pH value in the acceptable range and of the use of an alkaline process in its manufacture may be accepted as proof that the paper meets this requirement. As confirmation, an indication of the approximate pH of the core paper may be obtained by: (a) splitting the paper, using a dry delaminating method to expose a core surface, and determining a value of the pH of the core paper by surface measurement in accordance with TAPPI T529 om-88 as modified⁷ or (b) applying a pH indicator (e.g., chlorophenol red as liquid or in an indicator pen) to the core surface.

7. Disregard Par. 8.5 of the TAPPI method. Do not wait for equilibrium — take reading between no less than 15 seconds (to allow for surface electrode stabilization) and no more than 30 seconds (to avoid the effects of possible diffusion of coating constituents into the core as a consequence of the test procedure).

Table 3 — Tear resistance values for commonly encountered weights of coated paper

Grammage (g/m ²)	Basis weight of book paper (lbs)	Minimum average machine-direction tear resistance (g)	Minimum average machine-direction tear resistance (mN)
105	70	37	363
90	60	32	314
75	50	27	265
65	45	24	235

Note: Extraction methods (e.g., TAPPI T509 om-88) are not appropriate for determining the pH of the core of a finished coated paper. It is not possible to obtain reliable pH values for core paper by these methods due to the difficulty of isolating the core paper from the coating. The coating normally has a pH value different from the pH value of the core paper.

5.2. Tear Resistance

Minimum average machine direction tear index of 3.50 mNm²/g (see TAPPI T414 om-88).

Table 3 lists for several commonly encountered weights of paper the resistance values in grams and millinewtons which are equivalent to a tear index of 3.50 mNm²/g.

Note: Since a coating typically accounts for one third of the total mass of coated paper, a tear index of 3.50 mNm²/g for the coated paper as a whole is generally equivalent to a tear index of 5.25 mNm²/g for the core paper, exclusive of coating.

5.3. Alkaline Reserve

Minimum alkaline reserve equivalent to 2% calcium carbonate, based on oven dry weight of the entire paper, including the coating. (See ASTM D 4988-89.)

5.4. Paper Stock

The paper shall contain no more than 1% lignin by weight of the fiber content of the paper, as indicated by a Kappa number not greater than 7. (See TAPPI T236 cm-85.)

Note: Testing has shown that some papers with higher lignin levels which otherwise meet the requirements of this standard can exhibit

excellent retention of physical strength after accelerated aging.

6. Notice of Compliance

6.1. Symbol and Statement of Compliance

All publications printed on paper that meets this standard should carry the following information:

This paper meets the requirements of ANSI/NISO Z39.48-1992 (Permanence of Paper).

The compliance symbol is the mathematical symbol denoting infinity set inside a circle:



6.2. Placement of Symbol and Statement in Printed Materials

The information in 6.1. shall appear on the verso of the title page of a book or on the masthead or copyright area of a periodical publication. In addition either the symbol or statement or both may be used in any other position on the product.

6.3. Use in Advertising, Packaging, Promotion, Reviews, and Cataloging in Publication

For all paper and publications that comply with this standard, the statement, symbol, or both, should be used in advertising, packaging, promotion, reviews, and sales catalogs. Publishers should also indicate compliance with this standard when they submit material to the Cataloging in Publication (CIP) program. The CIP data will then include this information.

NISO Standard Evaluation Form

Standards are intended to be useful. However, information on where, when, and how standards are used, and with what results, is difficult to obtain. The purpose of this form is to provide users of this document with a convenient way to communicate about that use to those responsible for the NISO Standard. Your feedback can have an important effect, not only on future versions of this NISO Standard, but on the way other NISO Standards are created. If you have used (or are planning to use) this NISO Standard in any way, please complete this form and return it at your earliest convenience. Thank you for helping us to improve the NISO Standards you use.

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